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ABSTRACT

Mentally retarded subjects who could read were tested on their ability to pronounce words and to produce meaningful associates. Analyses of their responses indicated an overuse of a strategy of memorizing words as a way to recognize words in print and an inability to consider word meanings in terms of abstract referents. A comparison of these results with responses given by normal children suggested that the retarded used cognitive strategies which led to inefficient reading and even interfered with the development of effective reading skills. (Author)

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Technical Report No. 58

THE ROLE OF STRATEGY IN READING BY THE MENTALLY RETARDED

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Abstract

Mentally retarded subjects who could read were tested on their ability to pronounce words and produce meaningful associates. Analyses of their responses indicated an overuse of a strategy of memorizing words as a way to recognize words in print and an inability to consider word meanings in terms of abstract referents. A comparison of these results with responses given by normal children suggested that the retarded used cognitive strategies which led to inefficient reading and even interfered with the development of effective reading skills.

The Role of Strategy in Reading by the Mentally Retarded

Mental ability and reading skill are closely related, being dependent, presumably, on perceptual strategies and abilities to manipulate abstract representations of information. Recent research on mental retardation and current work on reading and memory processes suggest that the kinds of cognitive strategies readers employ are likely to be a crucial factor (Brown, 1974; Campoine & Brown, 1977). The study reported here was intended to determine whether the mentally retarded utilize ineffective strategies for identifying and remembering printed words.

Studies of the development of reading skill show that even unskilled readers have a substantial understanding of the structures of our language. In particular, normal children make use of orthographic organization of letters (Shankweiler & Liberman, 1972) and phonological patterns (Caefee, Lindamood & Lindamood, 1974) to pronounce words. They are able to interpret both concrete nouns and abstract words in a way that shows a substantial knowledge of the categorical structure of word meanings (Mason, 1977).

Knowledge of the phonological structure of words has been shown to change as readers become more skilled. Mason (1976) found in a word pronunciation task that the least skilled readers made more errors on uncommon words and were not helped by the regularity of a vowel pattern. More skilled readers were not so affected by the

commonness of the word itself but were substantially impaired if the word contained an irregular vowel pattern. It was concluded that readers first employ a strategy of memorizing words and then shift to a strategy which utilizes letter-sound regularity. The question of interest here is whether the mentally retarded use strategies that are similar to the least skilled readers. That is, one explanation for the mentally retarded to be poor readers is that they do not learn, as normal readers do, to use letter-sound patterns to identify words in print.

Some research supports this notion: the retarded do not easily perceive redundant patterns. They do not cluster numbers into fewer units even when that strategy would facilitate recall (Gerjuoy & Spitz, 1966; Gerjuoy & Alvarez, 1969; Macmillan, 1972). Only repeated trials or being given cues on how to cluster improves recall (Spitz & Webreck, 1972). This perceptual disability is likely to interfere with the development of appropriate word recognition strategies. That is, English is quite regular at the letter cluster level of analysis (Venezky, 1970); thus, efficient reading must include an awareness that consonants and many letter clusters have predictable sounds. Since a significant proportion of redundant patterns may not be formally taught (e.g., -ight, -old, -are, -ll, -ble), a mentally retarded child or adult may never notice the regularity contained in letter groups, particularly in vowel-consonant cluster patterns. Without that awareness, a reader cannot shift to a letter-sound identification of new words. A beginning reading strategy of whole word memorization, an overuse

of context to guess unknown words, and a disregard of letter information may then be the outcome.

The paired associate literature indicates another potential source of reading difficulty for the retarded. Gascon and Goodglass (1970) found a facilitative effect on recall for retarded subjects of stimulus enrichment, particularly when the stimulus was of a visual nature. Retarded adults recalled picture-picture pairs better than picture-word pairs (Yarmey & Bowen, 1972) while normal readers achieved superior recall with picture-word pairs (Paivio & Yarney, 1966; Dilley and Paivio, 1968). Further, low ability children made significant improvements in a verbal abstraction task when they were shown pictures of the stimuli while normal ability children were not helped by the pictures. These studies suggest that the retarded sustain a verbal coding processing deficit. One implication for reading is that meanings of abstract words should be less well remembered than meanings of words with concrete referents. As a result, overemployment of a strategy of relying on concrete meanings is likely to hamper text interpretation.

Two kinds of word reading disabilities among mentally retarded readers were predicted: (1) an employment of a word memorizing strategy to identify and pronounce words and (2) a reliance on concrete information to remember the meanings of words. The predictions were tested by asking subjects to pronounce sets of words and give meaning-related associations to the same words. Responses were

compared with those made by normal children in order to determine whether or not the retarded make the same kinds of errors. This comparison was possible because the same words and similar tasks had been given to normal children (Mason, 1977).

Experiment 1

Method

Subjects. Twenty-four mentally retarded subjects, all but 3 of whom were 12-16 years old (these 3 were 32, 36, and 49 years of age), and were living in a large institution for the retarded, were tested. Their mental age averaged 8.0, ranging from 5.8 to 12.1; 15 were males. They had an IQ of at least 45 with no other known organic impairment; their mean IQ was 63. They were selected primarily on the basis of their age (adolescence) and an ability to read. All the subjects were able to read 25% or more of the words on the test.

Materials. Six sets of 16 one-syllable words were selected from Venezky (1962), a listing that was taken from the Thorndike and Lorge corpus. All but one word that was selected (EARL) began and ended with a consonant. Each set of 16 words was sorted according to five word properties: vowel complexity, vowel regularity, word length, word frequency, and concreteness. Vowel complexity was defined by the number of vowels in a word: one vowel or a vowel pair (e.g., BIRD/SAID or TRACK/BREAD). Vowel regularity was determined according to

Venezky's (1970) analysis of English letter-sound correspondences. The most frequent correspondence was called "regular" (e.g., TRACK or COAX); all other correspondences were considered "irregular" (e.g., BULB or SWEAT). Word length was limited to four- and five-letter string comparisons in order to avoid confounding length with other properties. Word frequency was originally defined according to extreme values from Thorndike-Lorge rankings. These values were later compared with the more current Carroll, Davies, and Richmond (1971) frequency tables. Median frequencies for high- and low-frequency words were 111 and 1.2 per million respectively; mean values were 246.2 and 3.6 per million, respectively. The ranges, 6 to 3,062 and 0 to 28 per million, overlapped because WEED, STEAK, and GRIND had to be classified as high-frequency words and BULB, LENS, and SWEAT filled out the low-frequency portion of the design. Concreteness was defined in terms of objectivity. Names for real objects represented concrete words; verbs, adjectives, and abstract nouns represented nonconcrete words. When possible, nouns were chosen so that more than half of the nonconcrete words were abstract nouns. Materials are listed in Appendix A.

Procedure. An experimental session consisted of six blocks. Within a block, which contained 16 randomly ordered stimulus words, a prefamiliarization was followed immediately by two tasks. The first task was to read the 16 words and, after correcting any errors, the second task was to give a meaning-related association response.

The second task was explained by example. They were told that if the word was man, they could have responded with "woman" or "boy"; if the word was rug, they might have said "floor" or "carpet".

Before each of the 6 blocked tasks, the words and their meanings were prefamiliarized. Using a Latin square ordering, subjects (1) were shown a picture and heard a sentence that described the word, (2) were shown the printed word and heard the same sentence, or (3) were given no prefamiliarization. In addition, if they saw the printed word, it was displayed in either upper or lower case.

Subjects were not held to formal time limits. However, if a subject remained silent for several seconds on the pronunciation task, he/she was urged to guess. On the association task, the experimenter repeated the question, then if there was no response within 10 seconds, the next word was presented.

Design. A one-half fractional factorial design (Kirk, 1968) was employed for the 2 x 2 x 2 x 2 x 2 word property portion, thus reducing each word set to 16. Six word sets were produced, constituting 96 words altogether. The prefamiliarization condition was confounded with the ordering of the six word sets in a Latin square design. This meant that a 3 x 2 design was imposed on the word sets. These were the within-subjects variables. The between-subjects portion of the design consisted of the six Latin square sequences.

Scoring. The correct pronunciation of each target word was determined by referring to Webster's New World Dictionary (1957).

Any major discrepancy between the subject's pronunciation and Webster's was counted as an error; dialects other than Standard English and articulatory anomalies were rare among the subjects tested.

Correctness for the meaning-related analysis was determined by defining a correct response as a word of the same part of speech and either categorically related (e.g., BIRD-robin, MUSH-cereal, or RICH-poor) or functionally related (e.g., NAIL-hammer, CLEAT-shoe, TRACK-train). Wrong responses could be a word of another part of speech that was contextually relevant (e.g., POST-man, POINT-finger, HEART-beat), a rhyming association, a wild response, or no response. When a response could be scored in more than one category, the more meaningful response was recorded (e.g., BIRD-fly or PLANT-seed).

Results

Separate analyses of variance were carried out for the pronunciation and meaning-related tasks. Following Clark (1973), quasi-F ratios were used to test the significance of word properties (min F' $= \frac{F_1 F_2}{F_1 + F_2}$ where F_1 is the F value when words are considered a random factor and F_2 is the F value when subjects are considered a random value). On the pronunciation task, the only significant effect was the word frequency property (min $F'_{1,77} = 101.6$, $p < .001$). On the meaning related task, word frequency (min $F'_{1,119} = 5.0$, $p < .05$) and concreteness (min $F'_{1,114} = 29.4$, $p < .001$) were significant. There were no effects of prefamiliarization on either task, a result to be

expected if subjects' ability to read was hampered by the strategy employed rather than by the familiarity of the material alone.

Discussion

On the pronunciation task, the retarded subjects were affected strongly by word frequency--common words were readily pronounced while uncommon words were usually mispronounced. An omega square statistic (Hays, 1963, p. 382) was computed to show that 44% of the variance on the pronunciation task was accounted for by word frequency. Since subjects were not similarly affected by any of the letter pattern variables, the low scoring for uncommon words suggests that the retarded typically used a recognition strategy of memorizing whole words, a method of learning words that is more characteristic of beginning readers.

Both the concreteness and word frequency variables affected subjects' ability to recall meaning-related word associates. Concreteness was an especially influential variable, accounting for an estimated 30% of the variance (using omega square). This result agrees with the differences between retardates and normals found in the paired associate literature. Here, in assigning word meanings, the retarded often gave a concrete response, resulting in a higher score for concrete nouns.

The pronunciation error rates of the retarded subjects were compared with grade 2 and grade 5 average ability subjects who had been given the same pronunciation task and words. The meaning-related errors were compared with a different normal group (grades 1 and 3)

in order to have identical tasks (both normal groups are described in more detail in Mason, 1977). The means are listed in Tables 1 and 2.

The mentally retarded subjects mispronounced 14 to 67% of the words, a 37% average error rate, while fifth graders had a 10% error rate and second graders a 32% error rate. Although the mental age and overall error rate of the retardates were similar to second graders, the distribution of errors differed. Retardates knew more of the common but fewer of the uncommon words; they were also less affected by vowel complexity and vowel regularity. The differing pattern of errors suggests that grade 2 children, being in the process of acquiring notions of letter-sound regularity, were hampered by vowel-sound irregularity and unfamiliar vowel digraph patterns. Retardates, however, were profoundly affected by uncommon words but less so by letter patterns; thus, retardates appear to have relied on a whole word memorization strategy rather than letter-sound pattern information.

A comparison of the kinds of errors made by each group confirmed this supposition; the retarded subjects tended to make errors that reflected reliance on common words rather than letter information. They often turned the word into a familiar word (SKIP for SKIMP, COAT for COAX), read only a common shorter word that was embedded in the uncommon word (EAR for EARL, YES for YEAST, BUS for BUSH), made more errors on the end of the word than the beginning (SEEM for SEEP, JOTS for JOLT), and frequently misread consonant clusters (CLASS for CLASH, MUCH for MUSH).

These errors indicate that the retarded subjects made an unusual type of overgeneralization. Instead of an overuse of common vowel patterns which is typical of normal children (Mason, 1976), they relied on short, common word patterns. They often discounted vowel and even consonant information by guessing a common [illegible] was somewhat similar. Unfortunately, this is a bad strategy in reading English words because many common words contain non-regular letter-sound patterns which do not form a satisfactory foundation for generalization (e.g., was, there, have, one). Thus, using common word patterns instead of regular letter patterns has led these subjects to fail to recognize words unless they memorize every printed word.

A comparison of rates on the meaning-related task indicated that the retardates had an overall error rate most like the grade 1 subjects (79% for retardates, 76% for grade 1 and 61% for grade 3). However, like the pronunciation task, the distribution of errors differed markedly. Normal children made proportionally more errors on uncommon words while the retarded were severely affected by words which did not have a concrete referent. When normal children had some familiarity with a word, they were usually able to think of a categorically related word. When they did not know the word, they tended to give no response at all. Retarded subjects, by contrast, were very severely limited by the abstractness of the target word and were less affected by its familiarity. For example, the words THINK, SAID and NEXT were much harder than PLANT, NAIL and CHAIR. When they gave

an incorrect response, it was frequently a morphologically or syntactically related word (TEACH-teacher, WEAR-clothes, or CROSS-nail to), a name (SEAR-Sears Roebuck) or an idiosyncratic response (KICK-kick the habit or WRONG-wrong to steal). They seldom made no response.

The difference can be illustrated by comparing responses made by each group. To the word KICK, over half the responses made by normal children were the verbs hit, stamp, jump, throw. None of the retarded subjects gave a verb response but they often gave a noun response (football, ball, boy, door, habit, horse, leg). The word GOOD generated the word bad by most of the normal children (or, less frequently, nice, right, and beautiful). Among the retarded subjects, one said right while most of the responses were noun phrases (GOOD boy, home, food, pie, children, dog, etc.). With concrete nouns, although the number of meaning-related responses was higher, the retarded mentioned terms that were categorically more distant. For example, normal children responded to RAIN most often with snow, water, and sun. Only one retarded subject mentioned water. More common were the responses outside, summer, outdoors, sky, flowers, and thunder.

A diagram describes differences on correct responses between the two groups. In Figure 1, the subordinate terms are placed below the term, superordinate terms above, synonyms or antonyms horizontally, and location and functionally related terms on a diagonal. The diagrams show different structures even on meaning-related responses (omitting incorrect responses of compound words, syntactic associates, and unrelated words). Normal children responded with a large number of superordinate

terms, antonyms and close synonyms. The retarded gave a large number of functional terms. The first structure, reflecting normal children's responses, is more fitting to an addition of new terms and a merging into larger conceptual units. The other, constructed from retardates' acceptable responses, is replete with loosely organized functional terms; it cannot so easily be expanded to create hierarchically related concepts.

These analyses have gone beyond the original finding of a difference in word reading between normal and retarded subjects. They are, however, related to the notion that the retarded employ word attack and word learning skills which interfere with reading. A reliance on a word memorizing strategy to pronounce words means that unless most of the words are common or the context provides distinctive cues for word recognition, the retarded will be unable to identify a substantial number of words. Additionally, a dependence on concrete referents suggests that meaningfulness of verbal information may be another serious problem in reading.

It is apparent that reading pracitce, drill, or vocabulary review will not be a satisfactory means to improving retarded readers' skills. The strategies they are dependent upon will continue to have an adverse effect unless training materials and teaching methods are appreciably revised. The recent research by Brown and Campione (1977) and Campione and Brown (1977) suggests that strategy training will be a necessary component for achieving an improvement in retardates' ability to read.

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Table 1

Pronuciation Error Rates as a Function of Population Group and Word Properties

Word Property		Retarded	Grade 2	Grade 5
Word frequency				
	Common	.16	.21	.02
	Uncommon	.59	.42	.18
Word length				
	Four letters	.34	.30	.10
	Five letters	.40	.33	.10
Vowel regularity				
	Regular	.34	.28	.09
	Irregular	.40	.35	.11
Vowel Complexity				
	One vowel	.37	.25	.08
	Vowel pair	.38	.38	.12

Table 2

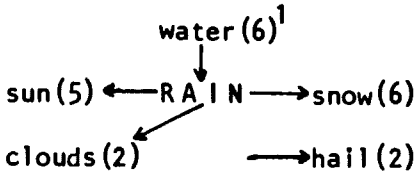
Meaning-related Error Rates as a Function of Population Group and Word Property

Word Property		Retarded	Grade 1	Grade 3
Word frequency				
	Common	.74	.64	.46
	Uncommon	.84	.89	.75
Word concreteness				
	Concrete	.68	.73	.59
	Non-concrete	.91	.79	.63

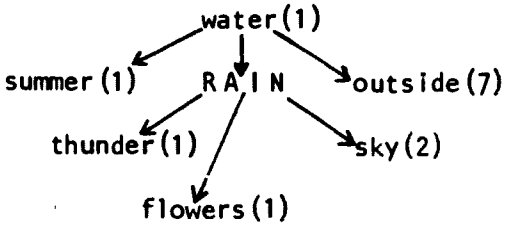
Figure Caption

Figure 1. Meaning-related responses given by normal children and related subjects.

Normal Children



Retarded Subjects



[1]Number in parentheses indicates how many subjects made that response.

Appendix A

Category Description of All Words Used in the Study

	Five-letter words				Four-letter words			
	+C+F	-C+F	+C-F	-C-F	+C+F	-C+F	+C-F	-C-F
+1 V +REG	stick			skimp		rich	mush	
	plant			glint		much	scab	
	dress			bland		kick	bulb	
	track			clash		held	puck	
	clock			hunch		bend	lens	
	cliff			slump		next	spat	
+1 V -REG		blind	thong		bird			molt
		wrong	floss		bold			balk
		truth	wharf		post			jolt
		grind	shard		bush			surd
		thank	tongs		salt			volt
		thing	knoll		bank			purl
-1 V -REG	heart			guild		wear	soot	
	bread			leant		dead	rook	
	brook			dealt		good	prow	
	steak			tread		look	weir	
	floor			sweat		said	earl	
	blood			weird		been	lead	
-1 V +REG		speak	yeast		rain			laud
		teach	cairn		nail			coax
		south	pouch		meat			seep
		point	sloop		seed			veer
		clean	shoal		weed			seer
		reach	cleat		boat			moot

Key: +C = concrete word; -C = not concrete word
+F = high frequency word; -F = low frequency word
+1 V = one-vowel word; -1 V = two-vowel word
+REG = regular pronunciation for vowel
-REG = irregular pronunciation for vowel

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